Tab A

TA
A

ILLUSTRATIONS

Scientific advances are mostly preceded by some mathematical investigations. This has been the history of science. Newton devised the calculus before he could develop his mechanics. Fermat and Pascal developed the theory of probability in order to decide the proper division of stakes, a problem posed by the gambler, Chevalier de Méré. Heaviside developed his operational calculus to enable the construction of the first trans-Atlantic cable. Gauss developed the method of least squares to get the closest approximation to statistical data. Hamilton created quaternions for the representation of three-dimensional dynamics. The "Kitty Hawk" of the Wright brothers was preceded by much careful experimentation and calculation. Napier's invention of logarithms played an important part in gaining the British control of the sea, by simplifying navigational computation.

Representative but not limiting examples will illustrate the possibilities of correlating techniques with applications:

1. Mathieu functions are applicable to non-linear oscillations with perturbation and have been applied to the oscillation of airfoils, to acoustic and electromagnetic wave propagation, and to electron optics.

2. Green functions, used in potential theory, have been used in connection with corrugated antennas.

3. Elliptic differential equations have applicability in heat conduction, the theory of elasticity, and subsonic fluid dynamics.

4. Hyperbolic partial differential equations of the second order apply to supersonic aerodynamics and to the shock waves of supersonic projectiles and explosive detonations.

Tab B

MATHEMATICS AS AN INDICATOR SOURCE

The Soviets place great emphasis on mathematics. They publish many journals devoted exclusively to pure and applied mathematics, as well as many others which include some mathematical articles. Because the Soviets take justifiable pride in their mathematical accomplishments, they make such publications openly available. All this is done under a state controlled economy where, even in their mathematical work, they emphasize the need for "devotion to the building of the great socialist economy."

This open Soviet mathematical literature is a fertile field for intelligence production. Since much preliminary mathematical work is required before many scientific and technical developments can be fully carried out, an intelligence advantage is hereby offered. In the past, sudden and special interest in formerly neglected or non-existent mathematical techniques has been engendered by needs in certain technological developments. In other cases, increased mathematical emphasis has been concomitant with new technological activities of specific character.

Such potential indicators should not be overlooked, particularly when the time advantage offered by mathematics as "the handmaiden of the sciences" is considerable.

A two year warning was shown in the analysis of all Soviet mathematical publications during the period 1937-1942. It is possible that this advantage could be increased. Inasmuch as the brief papers (sometimes as many as six in a series) in the Doklady Akademii Nauk are harbingers of subsequent fully developed papers, and precede them by from ten to twenty months, a careful analysis of the reliability of these DAN notices might show that an analysis of these alone would prove of significant advantage for intelligence purposes, possibly with a time lead of as much as three years ahead of technological application and production.

Certain mathematical techniques are rather restricted in their applications, and their correlation with recognized applicability rather definite, even to the extent of pinpointing a logical conclusion. The offering of two alternatives, in some circumstances, could be of considerable interest. The logical intersection of various arguments could be relied on for more specific determination.

STAT

PROCEDURE

Essential bibliographic data on basic Soviet mathematical publications (Doklady, Izvestia, Sbornik, Uspekhi, Prikladnaya, Steklov Trudy, etc.) would be coded on IBM cards, along with the mathematical category of the subject. These cards would then be run on a sorter and tabulator in order to supply running statistics on:

1) the number of papers in each of, say, ten mathematical categories (logic and foundations; theory of numbers; algebra; function theory; differential equations; calculus of variations, integral equations, and functional analysis; numerical and graphical methods; theory of probability; geometry; history);

2) the total number of papers in each journal and in all categories.

Month by month charts of these statistics would be kept current. Appropriate statistical tests of significant deviations would be devised. These tests, once devised, could be completely mechanized on IBM or other modern digital computers, so that data from the IBM bibliographic cards could immediately supply a running index of Soviet mathematics activities, with deviations indicated.

Deviations thus indicated would be analyzed by going back to the original Soviet material to determine what probable meaning and purpose could be ascribed. The particular mathematical techniques used in those categories displaying abnormal deviations would be investigated for implications.

In order to enable the surer and more rapid interpretation of findings, a correlation file would be established for the use of the analysts. This would be developed from the careful analysis of our own available mathematical literature, both classified and unclassified, for the purpose of establishing a cross-index between various specific mathematical techniques and their specific applications in various applied technical fields. For the classified documents, a thorough analysis of the ASTIA files is proposed.